47. A user station receiver according to claim 39, wherein at least one said transmitter module of one of the base stations uses a plurality (N_m) of different spreading codes to spread respective ones of said series of symbols for simultaneous transmission in the same frame, such that the component of the received signal (X(t)) corresponding to that base station transmitter module comprises a corresponding plurality of spread signals, and at least one (20U') of the plurality of receiver modules further comprises amplitude estimation means ($30U^{v'}$) for deriving total amplitudes $(\psi_n^{v',1},...,\psi_n^{v',NI})$ of a set of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ produced by beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ thereof, said beamformer means $(47U^{v',1,1},..,47U^{v',NI,N_m})$ uses different sets of weighting coefficients to weight each element of said observation vector $(\underline{Y}_n)$ to form said plurality of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ corresponding to said respective ones of said series of symbols and the symbol estimating means $(29U^{v',1,1},..,29U^{v',NI,N_m})$ derives from the plurality of signal component estimates $(\hat{s}_n^{v',1,1},...,\hat{s}_n^{v',NI,N_m})$ a corresponding plurality of symbol estimates $(\hat{b}_n^{v',1,1},...,\hat{b}_n^{v',NI,N_m})$, said observation vector deriving means comprises despreading means $(19^{v',\Sigma,1},...,19^{v',\Sigma,N_m})$ for despreading the observation matrix (Y_n), using one or more of said plurality (N_m) of different spreading codes, each of these codes being a compound code formed by averaging the codes of all others of said multiplicity of interfering users (NI), to form a plurality of observation vectors $(\underline{Z}_n^{v',\Sigma,1},...,\underline{Z}_n^{v',\Sigma,N_m})$, the channel identification means ($28U^{v'}$) derives from said plurality of observation vectors $(\underline{Z}_n^{v',\Sigma,1},...,\underline{Z}_n^{v',\Sigma,N_m})$, said signal component estimates $(\hat{s}_n^{v',\Sigma,1},...,\hat{s}_n^{v',\Sigma,N_m})$ and said amplitudes $(\psi_n^{v',1},...,\psi_n^{v',NI})$ a corresponding plurality of sets of channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},...,\hat{\underline{Y}}_{0,n}^{v',NI,N_m})$ and supplies the sets to said beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ and the coefficient tuning means of the beamformer means $(47U^{v',1,1},...,47U^{v',NI,N_m})$ uses the sets of channel vector estimates $(\hat{\underline{Y}}_{0,n}^{v',1,1},...,\hat{\underline{Y}}_{0,n}^{v',NI,N_m})$ to derive said different sets of weighting coefficients, respectively.

48. A receiver according to claim 1, each said receiver module it located in a user/mobile station and the received signal comprises a plurality of spread user signals transmitted by a plurality of transmitter modules at a base station communicating with said receiver via said channels.

49. A receiver for a CDMA communications system comprising preprocessing means (18) for deriving from a received signal (X(t)) a succession of observation matrices ($\mathbf{Y}_n$), means (44) for reshaping each observation matrix to form an observation vector ($\underline{Y}_n$), beamformer means ($27N^d$) for weighting each element of the observation vector using weighting coefficients and combining the weighted elements to form a signal component estimate $(\hat{s}_n^d)$, said beamformer means comprising tuning means for tuning said weighting coefficients in dependence upon a channel vector estimate $(\hat{\underline{Y}}_{0,n}^d)$, means ($29N^d$) for deriving from the signal component estimate $(\hat{s}_n^d)$ a corresponding symbol estimate $(\hat{b}_n^d)$ for output from the receiver module, means (19^d) for despreading the observation matrix using the spreading code of the corresponding user to form a post-correlation observation vector $(\underline{Z}_n^d)$, and channel identification means ($28N^d$) for deriving said channel vector estimate $(\hat{\underline{Y}}_{0,n}^d)$ in dependence upon said post-correlation observation vector $(\underline{Z}_n^d)$ and said signal component estimate $(\hat{s}_n^d)$.

50. A CDMA communications system comprising at least one base station and a multiplicity (U) of user stations ($10^1, \cdots, 10^U$) including a plurality (U′) of user stations served by said at least one base station, the base station capable of transmitting unique space-time encoded signals each dedicated to a corresponding mobile user station, each user station having a transmitter and a receiver for communicating with said at least one base station via a corresponding one of a plurality of channels ($14^1,\ldots,14^U$), the base station transmitter comprising:

a plurality of transmission antennas;

means for providing user-destined signals;

a distribution unit for grouping the user-destined signals into N_G groups;

a temporal channelization-code unit for spreading each user-destined signal by a unique dedicated code belonging to a fixed set of L orthogonal codes and summing the spread signals in each group;

means for adding to the summed spread signals of each group a respective one of a plurality of pilot signals each specific to one of the groups and generated by a PN code generator;

means for scrambling the summed signal from each of said groups using the same long scrambling code specific to the base station;

each pilot signal being assigned a fixed fraction of the total power transmitted from the base station transmitter;

means for mapping the signals from the groups $(G_1(t), \cdots, G_{N_G}(t))$ onto antenna branches $(A_1(t), \cdots, A_{M_T}(t))$ by means of a linear space coding (M) such that signals assigned to different groups are substantially orthogonal at transmission;

at least one of the user stations having a receiver for receiving the corresponding spread user signal transmitted by the base station, said plurality (U′) of user stations each having a unique spreading code assigned thereto for use by the user station and the corresponding one of the base station transmitter modules to spread the user signals of that user for transmission,

the spread user signals transmitted from the base station transmitter modules to a particular one of the plurality (U′) of user stations propagating via a plurality of channels ($14^1, \ldots, 14^{U'}$), respectively,

the receiver of a particular one of said plurality (U′) of user stations receiving a signal (X(t)) comprising components corresponding to spread user signals for said particular user station and spread user signals transmitted by other transmitter modules of said plurality (NB) of base stations for other users, each of said spread user signals comprising a series of symbols spread using the spreading code associated with the corresponding one of the user stations,

said user station receiver comprising:

a plurality (NB) of receiver modules ($20^{v'}$) each for deriving from successive frames of the received signal (X(t)) estimates of sets of said series of symbols from a corresponding one of the base stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules ($20^{v'}$) in a said frame to derive estimates of sets of said symbols, and

means (19,44) for deriving from each observation matrix a plurality of sets of observation vectors $(\underline{Y}_n^{v',1,1}, \ldots, \underline{Y}_n^{v',NI,F_{NI}}; \underline{Z}_n^{v',1,1}, \ldots, \underline{Z}_n^{v',NI,F_{NI}})$ and applying each of the sets of observation vectors to a respective one of the plurality of receiver modules ($20^{v'}$);

each receiver module comprising;

channel identification means ($28T^{v'}$) for deriving from the respective one of the sets of observation vectors a set of spread channel vector

estimates $(\underline{\hat{Y}}_{0,n}^{v',1,1},\ldots,\underline{\hat{Y}}_{0,n}^{v',NI,F_{NI}})$ based upon parameter estimates of the channel between the corresponding one of the base stations and said user station;

beamformer means $(47T^{v',1,1},\ldots,47T^{v',NI,F_{NI}})$ having coefficient tuning means for producing sets of weighting coefficients in dependence upon the sets of channel vector estimates, respectively, and combining means for using each of the sets of weighting coefficients to weight respective ones of the elements of a respective one of the observation vectors and combining the weighted elements to provide a corresponding set of signal component estimates $(\hat{s}_n^{v',1,1},\ldots,\hat{s}_n^{v',NI,F_{NI}})$ and

symbol estimating means $(29T^{v',1,1},\ldots,29T^{v',NI,F_{NI}})$ for deriving from the set of signal component estimates a set of estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}})$ of symbols spread by the corresponding one of the transmitter modules and transmitted by the base station;

said user station receiver further comprising means (42,43) responsive to said symbol estimates $(\hat{b}_n^{v',1,1},\ldots,\hat{b}_n^{v',NI,F_{NI}};g_n^1,g_n^2,g_n^3)$ and channel estimates $(\mathcal{H}_n^{v'})$ from each of said plurality (NB) of receiver modules, said channel estimates comprising at least channel vector estimates $(\underline{\hat{H}}_n^{v'})$ for channels ($14^{v'}$) between the user station receiver and said base stations, for providing at least one constraint matrix $(\hat{C}_n)$ representing interference subspace of components of the received signal corresponding to said spread signals, and in each of said receiver modules ($20^{v'}$), the coefficient tuning means produces said sets of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_n)$ and the channel vector estimates so as to tune said receiver module ($20^{v'}$) towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

51. A CDMA system according to claim 50, the transmitter further comprising:

delay means for delaying the signals from the mapping means each by a branch-specific delay, forming a corresponding signalling pulse modulating the signalling pulse with a carrier frequency signal, and supplying the modulated signal to the antenna elements for transmission thereby.

52. A CDMA system according to claim 50, wherein, in the transmitter, the grouping means is arranged to group data signals dedicated for user stations into a predetermined number N_G of groups and, when the number of users is less than or equal to the processing gain, assigning all user signals to the same group; otherwise assigning user signals pseudo-randomly so as to tend to balance the number of users in each group.

53. A CDMA system according to claim 50, wherein the transmitter further comprises, for each group, a space-time coding means comprising:

a channel coding unit for spreading user signals by a group specific set of orthogonal codes;

a scrambling unit for spreading each group of user signals with the same base station specific scrambling code; and

a spatial coding unit for mapping the total group signals $(G_1(t),\cdots,G_{N_G}(t))$ onto the antenna branch signals $(A_1(t),\cdots,A_{N_G}(t))$ by a linear transformation (**M**).

54. A CDMA system according to claim 53, wherein, in the transmitter, the channel coding unit assigns to each user in the group indexed g a chip-code chosen from a fixed set of $L_g \leq L$ orthogonal group specific L-chip codes $(a_{i,1}(t),\cdots,a_{i,L_g}(t))$. , the code-sets across groups being chosen subject to minimize the maximum cross-correlation, any code belonging to any group being orthogonal to any other code within the group while its cross-correlation with any out-group channelization code is minimized.

55. A CDMA communications system comprising at least one base station and a multiplicity (U) of user stations (10^1, ···, 10^U) including a plurality (U′) of user stations served by said at least one base station, each user station having a transmitter and a receiver for communicating with said at least one base station via a corresponding one of a plurality of channels ($14^1,\ldots,14^U$), at least one user station being capable of transmitting a user signal comprising a plurality of unique space-time encoded signals each carrying different data from that same user,

said at least one user station having a transmitter comprising:

a plurality of transmission antennas;

means for providing said user signals;

a distribution unit for grouping the space-time encoded signals into N_G groups;

a temporal channelization-code unit for spreading each different data stream of the user signals by a unique dedicated code belonging to a fixed set of L orthogonal codes and summing the spread signals in each group;

means for adding to the summed spread signals of each group a respective one of a plurality of pilot signals each specific to one of the groups and generated by a PN code generator;

each pilot signal being assigned a fixed fraction of the total power transmitted from the base station transmitter;

means for scrambling the summed signals from the groups using the same long scrambling code specific to the user station;

means for mapping the signals from the groups $(G_1(t), \cdots, G_{N_G}(t))$ onto antenna branches $(A_1(t), \cdots, A_{M_T}(t))$ by means of a linear space coding (M) such that signals assigned to different groups are substantially orthogonal at transmission;

the base station having a receiver for receiving a signal (X(t)) comprising components corresponding to spread signals transmitted by the transmitters of the plurality of user stations, each of said spread signals comprising a series of symbols spread using a spreading code unique to the corresponding user station, said base station receiver comprising:

a plurality (U′) of receiver modules ($20^1,\ldots,20^{NI},20^d$) each for deriving from successive frames of the received signal (X(t)) estimates of said series of symbols of a corresponding one of the user stations,

preprocessing means (18) for deriving from the received signal (X(t)) a series of observation matrices (Y_n) each for use by each of the receiver modules (20) in a said frame to derive an estimate of a symbol of a respective one of said series of symbols, and

means (19,44;44/1,44/2) for deriving from each observation matrix a plurality of observation vectors $(\underline{Y}_n; \underline{Y}_{n-1}; \underline{Z}_n^1 .. \underline{Z}_n^{NI}; \underline{Z}_n^d)$ and applying each of the observation vectors to a respective one of the plurality of receiver modules ($20^1,\ldots,20^{NI},20^d$); each receiver module comprising;

channel identification means (28) for deriving from one of the observation vectors a channel vector estimate $(\underline{\hat{H}}_n^1,\ldots,\underline{\hat{H}}_n^{NI};\underline{\hat{Y}}_{0,n}^d;\underline{\hat{Y}}_{0,n-1}^i)$ based upon parameter estimates of the channel between the base station receiver and the corresponding user station transmitter;

beamformer means ($27^1,\ldots,27^{NI},27^d$; 47^d) having coefficient tuning means (50) for producing a set of weighting coefficients in dependence upon the channel vector estimate, and combining means (51,52) for using the weighting coefficients to weight respective ones of the elements of a respective one of the observation vectors and combining the weighted elements to provide a signal component estimate ($\hat{s}_n^1,\ldots,\hat{s}_n^U$); and symbol estimating means ($29^1,\ldots,29^U$, $30^1,\ldots,30^U$) for deriving from the signal component estimate an estimate ($\hat{b}_n^1,\ldots,\hat{b}_n^U$) of a symbol ($b_n^1,\ldots,b_n^U$) transmitted by a corresponding one of the user stations ($10^1,\ldots,10^U$),

wherein said receiver further comprises means (42,43) responsive to symbol estimates ($\hat{b}_n^1,\ldots,\hat{b}_n^{NI}$; g^1, g^2, g^3; $g^{I+1,n}$) and to channel estimates ($\mathcal{H}_n^1 \ldots \mathcal{H}_n^{NI}$; $\mathcal{H}_{n-1}^i$) comprising at least said channel vector estimates ($\underline{\hat{H}}_n^1,\ldots,\underline{\hat{H}}_n^{NI}$) for channels ($14^1,\ldots,14^{NI}$) of a first group (I) of said plurality of user stations ($10^1,\ldots,10^{NI}$) to provide at least one constraint matrix ($\hat{C}_n$) representing interference subspace of components of the received signal corresponding to said predetermined group, and in each of one or more receiver modules ($20A^d$) of a second group (D) of said plurality of receiver modules, the coefficient tuning means ($50A^d$) produces said set of weighting coefficients in dependence upon both the constraint matrix ($\hat{C}_n$) and the channel vector estimates ($\underline{\hat{H}}_n^d$) so as to tune said one or more receiver modules ($20A^d$) each towards a substantially null response to that portion of the received signal (X(t)) corresponding to said interference subspace.

56. A CDMA system according to claim 55, the transmitter further comprising:

delay means for delaying the signals from the mapping means each by a branch-specific delay, forming a corresponding signalling pulse modulating the signalling pulse with a carrier frequency signal, and supplying the modulated signal to the antenna elements for transmission thereby.

57. A CDMA system according to claim 55, wherein, in the transmitter, the distribution unit means is arranged to group data signals dedicated for user stations into

a predetermined number N_G of groups and, when the number of users is less than or equal to the processing gain, assign all user signals to the same group, otherwise assigning user signals pseudo-randomly so as to tend to balance the number of users in each group.

58. A CDMA system according to claim 55, wherein the transmitter further comprises, for each group, space-time coding means comprising:

a channel coding unit for spreading user signals by a group specific set of orthogonal codes;

a scrambling unit for spreading each group of user signals with the same base station specific scrambling code; and

a spatial coding unit for mapping the total group signals $(G_1(t), \cdots, G_{N_G}(t))$ onto the antenna branch signals $(A_1(t), \cdots, A_{N_a}(t))$ by a linear transformation (M).

59. A CDMA system according to claim 58, wherein, in the transmitter, the channel coding unit assigns to each user in the group indexed g a chip-code chosen from a fixed set of $L_g \leq L$ orthogonal group specific L-chip codes $(a_{i,1}(t), \cdots, a_{i,L_g}(t))$. , the code-sets across groups being chosen subject to minimize the maximum cross-correlation, any code belonging to any group being orthogonal to any other code within the group while its cross-correlation with any out-group channelization code is minimized.

60. A receiver according to claim 1, for use with a transmitter transmitting pilot-symbol assisted user signals comprising pilot symbols multiplexed with data symbols, the receiver further comprising demultiplexing means ($35V^d$) for demultiplexing the signal component estimates from the ISR beamformer to extract pilot signal component estimates and data signal component estimates and supplying the data signal component estimates to the decision rule unit ($29V^d$) and the pilot signal component estimates to an ambiguity estimation means ($31V^d$), the ambiguity estimation means ($31V^d$) smoothing or averaging each pilot signal component estimate $(\hat{s}_n^{\pi,d})$ to provide an ambiguity estimate $(\hat{a}_n^d)$, conjugation means ($32V^d$) for deriving from the ambiguity estimate $(\hat{a}_n^d)$ its conjugate $((\hat{a}_n^d)^*)$ and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate $(\hat{b}_n^d)$ from the decision rule means ($29V^d$) to form an improved symbol estimate $(\hat{b}_n^d)$.

61. A receiver according to claim 1, further comprising a second ISR beamformer ($47V/2^d$) connected in parallel with the first ISR beamformer ($47V/1^d$) and responsive to the same channel coefficients and constraint matrix as the first ISR beamformer to derive from the observation vector $(\underline{Y}_n)$ a pilot signal component estimate, ambiguity estimation means ($31V^d$) for smoothing or averaging the pilot signal component estimate $(\hat{s}_n^{\pi,d})$ to provide an ambiguity estimate $(\hat{a}_n^d)$, conjugation means ($32V^d$) for deriving from the ambiguity estimate $(\hat{a}_n^d)$ its conjugate $((\hat{a}_n^d)^*)$ and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate $(\hat{b}_n^d)$ from the decision rule unit ($29V^d$) to form an improved symbol estimate $(\tilde{b}_n^d)$.

62. A receiver according to claim 60, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates $(\hat{a}_n^d)$.

63. A receiver according to claim 61, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates $(\hat{a}_n^d)$.

64. A receiver according to claim 39, for use with a transmitter transmitting pilot-symbol assisted user signals comprising pilot symbols multiplexed with data symbols, the receiver further comprising demultiplexing means ($35V^d$) for demultiplexing the signal component estimates from the ISR beamformer to extract pilot signal component estimates and data signal component estimates and supplying the data signal component estimates to the decision rule unit ($29V^d$) and the pilot signal component estimates to an ambiguity estimation means ($31V^d$), the ambiguity estimation means ($31V^d$) smoothing or averaging each pilot signal component estimate $(\hat{s}_n^{\pi,d})$ to provide an ambiguity estimate $(\hat{a}_n^d)$, conjugation means ($32V^d$) for deriving from the ambiguity estimate $(\hat{a}_n^d)$ its conjugate $((\hat{a}_n^d)^*)$ and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate $(\hat{b}_n^d)$ from the decision rule means ($29V^d$) to form an improved symbol estimate $(\tilde{b}_n^d)$.

65. A receiver according to claim 39, further comprising a second ISR beamformer ($47V/2^d$) connected in parallel with the first ISR beamformer ($47V/1^d$) and responsive to the same channel coefficients and constraint matrix as the first ISR beamformer to derive from the observation vector $(\underline{Y}_n)$ a pilot signal component estimate , ambiguity estimation means ($31V^d$) for smoothing or averaging the pilot signal component estimate $(\hat{s}_n^{\pi,d})$ to provide an ambiguity estimate $(\hat{a}_n^d)$, conjugation means ($32V^d$) for deriving from the ambiguity estimate $(\hat{a}_n^d)$ its conjugate $((\hat{a}_n^d)^*)$ and multiplier means ($15V^d$) for multiplying the conjugate with the symbol estimate $(\hat{b}_n^d)$ from the decision rule unit ($29V^d$) to form an improved symbol estimate $(\hat{b}_n^d)$.

66. A receiver according to claim 64, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates $(\hat{a}_n^d)$.

67. A receiver according to claim 65, wherein the ambiguity estimation means comprises a buffer for buffering bit estimates, smoothing means for smoothing or averaging the buffered estimates and a further decision rule unit ($29V/2^d$) for deriving from the smoothed or averaged estimates said corresponding ambiguity estimates $(\hat{a}_n^d)$.

68. A receiver according to claim 19, further comprising buffering means (90^i), deinterleaving means (91^i), channel decoding means (92^i), re-encoding means (93^i) and re-interleaving means (94^i) for buffering a first frame of signal component estimates $(\hat{s}_{n-1}^i(1))$, deinterleaving, channel decoding, re-encoding and re-interleaving the frame of signal component estimates to provide a frame of improved decided symbol estimates $(\hat{b}_n^i)$, and supplying same to the constraint set generator (42W), the constraint matrix generator (43W) forming therefrom an improved constraint matrix, the ISR beamformer ($47W^i$) using said improved constraint matrix to provide an improved signal component estimate $(\hat{s}_{n-1}^i(2))$ for use in a next iteration, the receiver repeating the iterations a predetermined number of times.

69. A receiver according to claim 39, further comprising buffering means (90^i), deinterleaving means (91^i), channel decoding means (92^i), re-encoding means (93^i) and

re-interleaving means (94^{i}) for buffering a first frame of signal component estimates $(\hat{s}^{i}_{n-1}(1))$, deinterleaving, channel decoding, re-encoding and re-interleaving the frame of signal component estimates to provide a frame of improved decided symbol estimates $(\hat{b}^{i}_{n})$, and supplying same to the constraint set generator (42W), the constraint matrix generator (43W) forming therefrom an improved constraint matrix, the ISR beamformer ($47W^{i}$) using said improved constraint matrix to provide an improved signal component estimate $(\hat{s}^{i}_{n-1}(2))$ for use in a next iteration, the receiver repeating the iterations a predetermined number of times.

70. A receiver according to claim 1, wherein coefficient tuning means ($50A^{d}$) produces said set of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_{n})$ and the channel vector estimates $(\underline{\hat{H}}^{d}_{n})$ so as to tune said one or more receiver modules ($20A^{d}$) each towards a response that is bound in magnitude to be close but not equal to a null.

71. A receiver according to claim 39, wherein coefficient tuning means ($50A^{d}$) produces said set of weighting coefficients in dependence upon both the constraint matrix $(\hat{C}_{n})$ and the channel vector estimates $(\underline{\hat{H}}^{d}_{n})$ so as to tune said one or more receiver modules ($20A^{d}$) each towards a response that is bound in magnitude to be close but not equal to a null.